THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 25. Thursday, May 11th, 1922. No. 299.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of
THE FOUNDRY TRADE JOURNAL,
BESSEMER HOUSE, 5, DUKE STREET, ADELPHI
LONDON, W.C.2.

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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Lessons from Mr. Samuelson's Presidential Address.

There was much of basic interest for foundrymen in Mr. Francis Samuelson's Presidential address to the Iron and Steel Institute. The question of chemical and mechanical tests has equal reference to cast iron, for periodically attempts are made to insist that for various purposes elements, usually designated as impurities, must be kept to certain low limits. As cast iron is much more complex than steel, we can very well follow up Mr. Samuelson's suggestion, that the chemical specifications should be as wide as possible, especially as regards sulphur, which, when adequately balanced, does not appear to be disadvantageous, as was once thought.

From the section headed "Future of Processes," foundrymen will note that whilst the operation of making pig-iron for the steelmaker presents great difficulties, the "making of foundry iron is cheap." Cheapness of pig-iron is essential for the iron foundry, but very often things which are cheap are nasty; however, so long as the "nasty" iron is blessed with the virtue of regularity of composition the more enlightened foundries will not grumble. For the smaller and poorer foundries, chemically irregular pig-iron will continue to be a source of trouble.

Coming to his section on "Blast Furnace Problems," Mr. Samuelson puts forward an interesting problem in economics. Whilst we agree with his remarks in so far as they apply to blast furnace practice, we cannot see that they apply to the general principle of replacing obsolete plant, because in foundry work the ability to produce a little cheaper than a competitor may be just the difference of staying in business or going into liquidation. We cannot help but feel that there may be a fallacy somewhere in the case put forward by Mr. Samuelson, for it almost seems axiomatic that modern plant, involving no experimental expenditure, must be a better commercial proposition in the long run than obsolete plant, providing its product can be sold. If the old plant had been annually depreciated until such times as it was worth nothing on the books, then the capital expenditure should only be the difference between the original cost of the obsolete plant and the new plant, with corrections for the scrap value of the former and any parts of the plant utilisable in the new proposition.

Mr. Samuelson's section dealing with ore supplies, too, is of interest to foundrymen, as it very largely explains the variations of composition of pig-iron as received by the foundrymen, to which reference has already been made. From this section the foundryman will be able to appreciate the problems of the blast furnace manager—the obvious lesson being the necessity for co-operation between the two. Foundrymen are not desirous of having continually to work to specifications, but at the same time, judging from multiplicity of ores tried in one furnace, feel that they would like to receive material of regular composition, as, in the ordinary way, their melting plant is mechanical rather than chemical. For this reason alone we consider that foundrymen have more right to impose specifications on the blast furnace proprietors than the steelmaker.

London I.B.F. Branch Visit B.T.H. Works at Rugby.

Last Saturday about thirty members of the London branch, by courtesy of the directors of Messrs. the British Thomson-Houston Company, visited their works at Rugby. The party were conducted round the foundries by Capt. Ayers and Mr. Roxburgh, the foundry manager. An innovation which was greatly appreciated by the members was the exhibition of a film showing the full details of the manufacture of a Curtis turbine. A lunch, at which Mr. Roxburgh presided, followed the visit, and opportunity was taken by Mr. H. O. Slater (Branch President) to propose the prosperity of the firm. This having been acknowledged by the Chairman, Mr. Wesley Lambert, president-elect, proposed the health of the directors and staff, coupled with the names of Mr. Roxburgh and Capt. Ayers, to which the latter replied.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Foundry Competitions at Birmingham.

To the Editor of The Foundry Trade Journal.

Sir,—I notice in your current issue a letter from Mr. J. Smith *re* the age limit of the above competitions.

The prospectus very clearly states on the first page that the competition is open to all under 21 years of age (except in Class C), and Section 1 in this class again very clearly states that this section is open to all over 21 years of age. The fact that a large number of entries have been sent in for this Section 1 points to its clearness.

Mr. Smith evidently has received one of the first issue of application forms, which were printed before Section 1 was arranged. Subsequent application forms make the necessary alteration.

I would like to take this opportunity to state that since the schedule of prizes was issued further prizes have been presented, particularly from the Worshipful Company of Ironmongers of a prize of ten guineas, which will be given as special prizes in Class C.—Yours, etc.,

Thos. Vickers,
Secretary.

Central House, New Street, Birmingham.

Foundry Accounts, Costs, and Statistics.

To the Editor of The Foundry Trade Journal.

Sir,—Mr. R. Dunkerley's Paper on "Foundry Accounts, Costs and Statistics" has provoked a good discussion, which, incidentally, demonstrates the increasing interest taken in costing by foundrymen generally. The author very rightly insisted that costing in some guise is in evidence in every business, for the mere collecting of information for the purpose of getting out an estimate is costing to a greater or a lesser degree. This being so, it is surely more economical to call it by its proper name, and see that it is efficiently handled.

The possibility of too much system was emphasised by one gentleman, but this surely can be avoided by prudent management. It is a far cry from the "sublime to the ridiculous," and yet there are some people who cannot arrive at the happy mean. The Paper read undoubtedly covered a fairly elaborate system, which would be far too expensive to be adopted in its entirety by any small concern. What appears to have been overlooked by the critics, however, is that the Paper was drafted out with a view to demonstrating the efficacy of *a* costing system, and did not purport to be *the* standardised system for all circumstances.

A system is devised to cater for a certain requirement, and because it is successful in the one foundry it does not follow that it will be equally so in another. This, on the other hand, does not prohibit its use for the purposes of illustration, and it is not unlikely that certain features of that system can be adapted, or improved upon, for use elsewhere. Many times has the writer pulled a published system to pieces, selected certain features, and incorporated these (with modifications) with his own organisation, with the happiest results.

The ordinary "rule of thumb" methods are of no use in these days of keen competition, and the foundry manager must *know*, before submitting the estimate, that the job will pay, and that he is an active competitor for the order. In regard to the latter statement, the manager will appreciate that the buyer has a reason for sending the inquiry, and, assuming special tackle to be necessary, the work covered by the order, or the volume of subsequent business which might reasonably be expected, will help him to come to a decision in regard to the estimate.

He may reasonably assume that similar castings have been produced in another foundry, and with not altogether satisfactory results. He should know whether the parts are well beyond his usual range, and he should know how his usual range compares with that of likely competitors. If he is a "wide" man, he will take these points into consideration, and it should not take him long to decide whether or not he can expect to handle the business.

The costing record assists him, inasmuch as it shows him (1) whether or not he has previously handled (or quoted for) similar work, (2) the cost of such work (if handled), (3) the circumstances at the time and the operators involved, and (4) the present circumstances, and what operators are now available. All these points are not, perhaps, given in detail, but the inference is there, and, at all events, the manager is working upon something definite, and not taking a plunge into the unknown.

The fact that it is known that the estimate is "not far wrong" is not good enough, for it must be known that it is *right*. The firm making the job for a penny, even though it spends two pence on system, shows, at all events, that it has achieved something from a production standpoint, whilst the firm making the job for twopence, and spending but a half-penny upon system, is self-condemned, because it has achieved nothing. There is hope for the first, because increased business can be handled without further administrative cost, but in regard to the latter, it is obvious that it cannot handle efficiently the business it already has.

But there is no necessity for system to be expensive, and although administrative costs increase as production costs decrease, they are not in anything like the same proportion. It is system that made it possible for a factory to turn out more in a 47-hour week than it did previously in 54 hours. This, perhaps, will be challenged, but the fact has been accomplished, as the writer has figures to prove.—Yours, etc.,

M. E. N.

Blast Foundry and the Foundry Cupola.

To the Editor of the Foundry Trade Journal.

Sir,—I have read the letter upon the above subject in your last issue signed by E. Adamson.

I suppose this letter is intended by the writer as criticism of Mr. Fletcher's paper given at Dudley, although I doubt if anyone will take it at all seriously. I have tried to read the letter twice over and I am left wondering what was the *real* object of the writer in penning it.

Mr. Fletcher's paper, which you have published *in extenso* to the delight of all your readers, is looked upon by blast furnacemen as one which every foundryman should read, and it has received unstinted eulogies from the metallurgists in this country and America.

I find, however, it is quite impossible to follow the somewhat erratic and loose arguments put forward by Mr. Adamson against a man who never hesitates to place his lifelong practical experience at the disposal of foundry managers. As Mr. Adamson very truly states, "a little knowledge is a dangerous thing," but does he not painfully confirm this by his letter? I would, for instance, suggest that he really gets acquainted with Sanier's process, the deductions from which as quoted by Mr. Fletcher have been accepted by Stead and other reliable men.

Take for example such crude generalities as Mr. Adamson's statement that (under certain conditions of blast furnace working) he found the total carbon increased with the rise in silicon. It sounds like a sea story; he calls it a phenomena. But still this crude statement, supported by absolutely no data or facts, is launched against Mr. Fletcher's formula for silicon supported by such men as Prof. Turner, Prof. Howe and Sandberg in their investigations.

Yours, etc.,

"Ferrite."

May 6, 1922.

[This letter has been abbreviated.—Ed.]

Gazette.

Coates (Walsingham), Limited, engineers and iron-founders, in liquidation. Mr. H. Sansom, Priest Gate, Darlington, C.A., was appointed receiver. April 21.

A receiving order has been made in the case of H. Mote, 15, Allesley Old Road, late 434, Foleshill Road, Coventry, metal merchant. Date of adjudication April 28.

E. J. Trawford, 80, Raleigh Street, Walsall, late Springfield Works, Darlaston, tube manufacturer, has been adjudicated a bankrupt. Examination, County Court, Walsall, May 24, at 10.15.

Cast Iron and its Chemical Composition.*

By O. Smalley

(*Continued from page* 326.)

Effect of Mass on Solidity.

In the first series of experiments conducted on mass effect, a set of 6-in. cubes were cast in the irons shown in Table III.

TABLE III.—*Compositions Utilised for Showing Mass Effect.*

	c.c.	Gr.	Si.	Mn.	P.	S.
1. ..	0.55	2.83	2.3	0.60	0.78	0.063
2. ..	0.24	2.88	2.49	0.52	1.28	0.050
3. ..	0.66	2.74	1.20	0.63	0.09	0.063
4A. ..	0.73	2.15	1.47	0.55	0.50	0.096
5. ..	0.60	2.67	1.15	0.62	1.54	0.086

Each was poured with 10 per cent. superheat into dry-sand moulds, the initial temperature being controlled at 110 deg. F. (43 deg. C.).

Fig 10 illustrates each cube after sectioning vertically through the middle.

In principle, these experiments confirm the results obtained from the draw test experiments and are self-explanatory of relation between chemical composition and mass so far as solidity is concerned. It will be observed that alloy No. 3 containing 1.2 per cent. Si and 0.07 per cent. P. is equally solid throughout.

According to Turner ordinary grey iron expands on solidification, the higher the silicon and the phosphorus content the greater the expansion and the wider the range of temperature through which it operates. What do Turner's expansion figures mean? Do they infer that grey cast iron does not shrink during solidification? If so, why did the high-silicon irons in the draw test bars shrink at the thicker portions, which shrink hole or spongy place is nothing more nor less than a pipe due to there being no residual liquid left to fill the interstices of the primary skeleton arms of the crystals, a defect all too common in iron castings. Again, why did the low Si and low P. iron, pipe the least in the 6-in. blocks? Surely the experiments conducted by Turner on the volume or rather linear changes with the T. test bar do not in any way represent the effect of the elements quoted on the volume changes of cast iron on solidification.

An important factor controlling liquid shrinkage and one which the author has not been able to associate with chemical composition is the "Time taken during solidification," it being well known that the more rapidly molten iron solidifies the lower the liquid shrinkage and the higher the degree of solidity throughout.

* A Paper read before the Newcastle Branch of the Institute of British Foundrymen.

Effect of Rate of Cooling on Solidity.

Fig. 11 represents three 6-in. blocks cast under identical conditions from the same ladle of metal, showing on analysis C. 3.28, Si 2.34, Mn 0.45, P 0.81, and S 0.066. No. 1 was cast into an exceptionally hard-rammed dry-sand mould having a temperature of 150 deg. F.; No. 2 in green-sand mould containing 6.78 per cent. H_2O at 70 deg. F. (21 deg. C.); and No. 3 in a sand mould lined with 1-in. steel plate at a temperature of 150 deg. F. (65 deg. C.).

These photographs typically portray the effect of "rate of cooling during solidification" on solidity of castings of large bulk. The explanation commonly accepted for this peculiar phenomenon is that the rigidity of the chill mould reverses the direction of the natural expansion of high silicon and high phosphorus irons whilst sand moulds give to it.

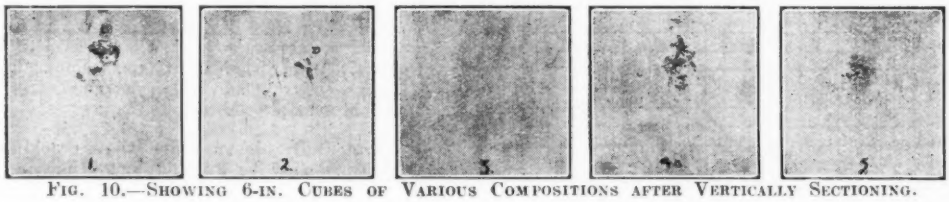

FIG. 10.—SHOWING 6-IN. CUBES OF VARIOUS COMPOSITIONS AFTER VERTICALLY SECTIONING.

There are three poignant factors against this hypothesis:—

1. The volume change of hard grey irons 1.3 to 1.5 per cent. Si, 0.30 to 0.70 per cent. P cast with the same degree of superheat is practically the same as that of soft grey irons, of from 2 to 3 per cent. Si and of high or low P content, so far as piping is concerned.

2. That all irons cast in green-sand moulds, which moulds possess an exceptionally low crushing strength, pipe less than dry-sand or loam-moulds which possess high crushing strength.

3. That the effect of temperature is more pronounced than chemical composition, *e.g.*, all irons pipe or draw if the metal is on the dull side, no matter the rigidity, temperature or form of the mould.

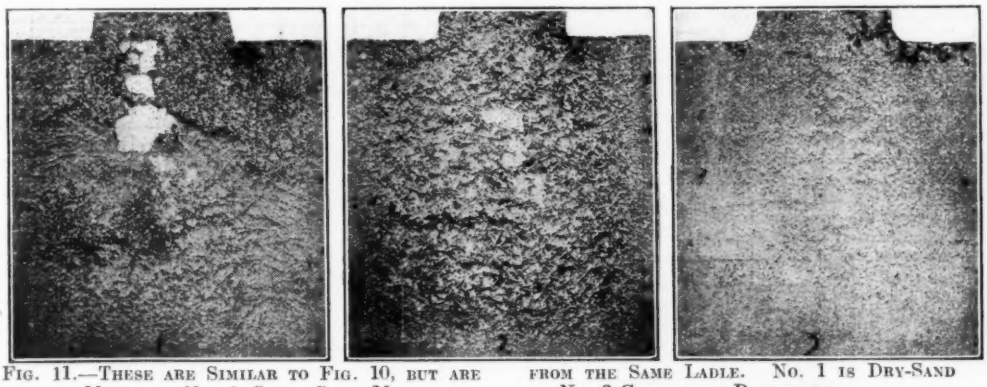

FIG. 11.—THESE ARE SIMILAR TO FIG. 10, BUT ARE MOULDED, NO. 2 GREEN-SAND MOULDED, FROM THE SAME LADLE. NO. 1 IS DRY-SAND AND NO. 3 CHILLED BY DENSENERS.

Solid Shrinkage.

By this is understood the contraction in cooling from immediate solidification to room temperature. During this period ordinary cast iron suffers from two stages of heat fragility, the one, at a comparatively high temperature when some liquid phase exists, the other at a low temperature ranging between 370 to 520 deg. F. (177 to 261 deg. C.).

If solidification of a casting be allowed to proceed uninterrupted little trouble is encountered with the high temperature fragility owing to the stretching capacity of cast iron at these temperatures. In fact, this power to stretch is such that almost any iron casting may be made with rigid chills without any fear of cracking. On further

cooling this stretch property falls and reaches a minimum at approximately 500 deg. F., the temperature at which cast iron suffers an appreciable loss in strength. This is shown graphically by Fig. 12. A represents an ordinary cylinder iron, B a 2 per cent. Si-low P iron, and C, a high Si-high P iron.

From these curves it is obvious that although silicon and phosphorus do not affect the heat fragility of cast iron, as will be shown later, they have an appreciable influence on the extensibility, hot and render the use of permanent cores as a practical proposition.

To demonstrate this in a more practical way a series of double "T" castings were made, fixing cast-iron bars 2-in. × 1½-in. section, in the mould, as shown by Fig. 13.

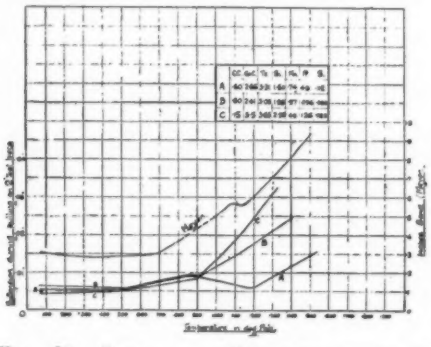

Fig. 12.—Shows the Extension found on Pulling 2-in. Test-Pieces at Various Temperatures.

Table IV. shows the composition irons used, each of which were cast with 10 per cent. superheat.

Table IV.—*Composition of Irons Used to Demonstrate Peat Fragility.*

	C.C.	Gr.	Si.	Mn.	P.	S.
1 ..	0.65	2.60	1.43	0.72	0.42	0.108
2 ..	0.58	2.59	2.00	0.70	0.10	0.092
3 ..	0.46	2.78	2.00	0.60	0.80	0.092
4 ..	0.52	2.62	2.59	0.67	1.75	0.046

Alloy No. 1.—This was cupola melted, and in the first experiment it was a cast in green-sand mould, and allowed to cool undisturbed, when it broke at 500 deg. F. (260 deg. C.).

In the second experiment it was again cast in a green-sand mould, but iron restricting-supports were removed at 1,100 deg. F. (590 deg. C.), and the casting allowed to cool slowly in a gas-heated muffle. This gave a sound casting.

Alloy No. 2.—In this case it was cast in a warm,

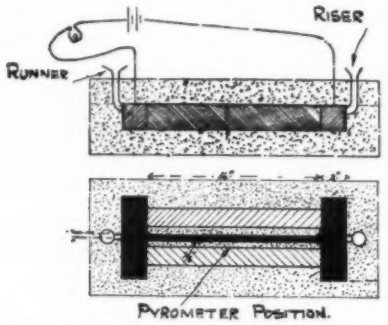

Fig. 13.—Form of Mould used to Demonstrate the Use of Permanent Cores.

dry-sand mould (150 deg. F.), and was allowed to cool undisturbed. It broke at approximately 530 deg. F. (275 deg. C.).

Alloy No. 3.—For the first experiment it was cast in green sand and allowed to cool undisturbed, when it broke at 570 deg. F. (290 deg. C.).

In the second test it was cast in warm, dry-sand mould, and allowed to cool undisturbed. This time it broke at 520 deg. F. (270 deg. C.).

The third test was carried out in a green sand, provided with iron restricting-supports which were removed at about 1,400 deg. F. (760 deg. C.), and the casting allowed to cool in the open, and it gave a sound casting.

The last experiment was cast in a warm, dry sand (70 deg. C.), in which the restricting supports were left in position, but was cooled slowly between two heavy iron blocks from 1,300 deg. F. (705 deg. C.). This, too, gave a sound casting.

Alloy No. 4.—Two experiments were made with this alloy, both giving sound castings. The first was cast in warm- dry-sand mould at 48 deg. C., and the restricting supports were left in position. In the second test it was cast in green sand and the restricting supports were left in position. Casting sound.

These experiments require little comment. They clearly indicate the relation between composition and casting strains in castings of complicated form

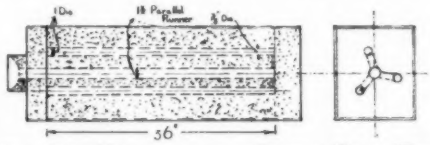

Fig. 14.—Mould used for Casting Three Test Pieces controlling Temperature both of the Mould and Metal.

and incidentally demonstrate that cracking in iron castings may be avoided by:—

(1) Releasing or removing restricting cores whilst the casting is at a dull red heat.

(2) By retarding the rate of cooling during the blue brittle range of temperature to a rate of approximately 10 deg. C. per hour.

(3) By accelerating cooling of heavier sections or retarding cooling of lighter sections, if conditions do not permit the selection of an iron of high-stretching capacity in the first place.

Effect of Composition on the Strength of Hot Cast Iron.

One naturally hesitates in showing any data concerning the effect of any single variable on the physical properties of cast iron, it being always problematic as to whether it is the effect of that variable or one of the many that inevitably creep

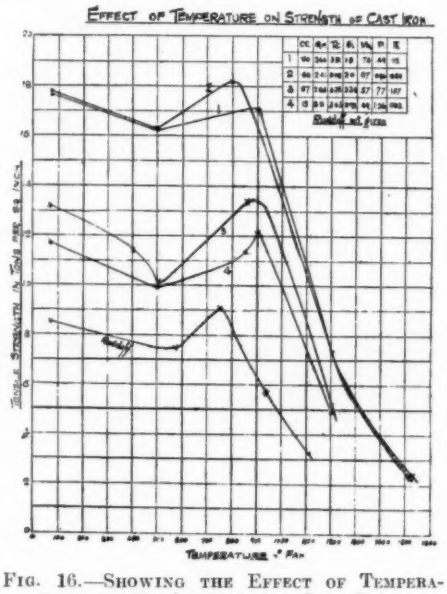

Fig. 16.—Showing the Effect of Temperature on the Strength of Cast Iron.

in owing to the complications involved. At the best the results obtained from any investigation on cast iron can only be comparative. Particularly does this apply to the tensile test which is controlled primarily by the form of the graphite carbon.

Again, owing to rapid deterioration of cast iron by heat and the lack of knowledge of the mechanism of this deterioration, the problem of temperature effect as associated with the chemical composition of the various grades of irons now made is pecu-

liarly difficult, and one feels very reluctant to express any views on the subject at all.

At the same time there exists a long-felt want for some reliable working knowledge of the behaviour of cast iron under conditions where well-known phenomena do not enter into consideration, and it is because of this that these experiments have been carried out. The irons selected are shown in Table V.

TABLE V.—*Composition of Iron Used Mechanically Testing at Elevated Temperatures.*

	c.c.	Gr.	Si.	Mn.	P.	S.
1. ..	0.60	2.66	1.50	0.74	0.49	0.112
2. ..	0.60	2.41	2.00	0.57	0.096	0.089
3. ..	0.37	2.88	2.24	0.67	0.77	0.107
4. ..	0.15	3.5	2.92	0.49	1.26	0.620

Three 1-in. bars were cast from each into dry-sand moulds in the manner shown by Fig. 14, controlling both temperature of the metal and the mould.

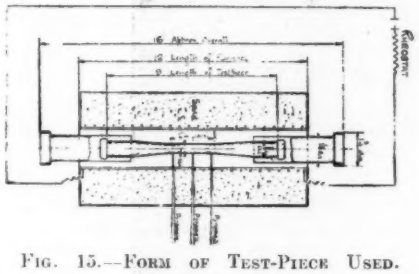

FIG. 15.—FORM OF TEST-PIECE USED.

The form of the test piece, the furnace used, and method of measuring the temperature are shown by Fig. 15.

Each test piece was heated to the specified temperature as quickly as possible, and retained at that temperature for exactly 1 hour before breaking.

The temperatures chosen were 70, 400, 500, 800, 860, 900, 1,200 and 1,530 deg. F. The lower temperatures 400-500 deg. F., to determine the loss in strength at the second period of heat fragility, the temperatures of 860 and 900 deg. F. were selected because of the distinct halt found in the cooling curve of the cast iron at about these temperatures; 1,200-1,530 deg. F. were chosen because of the remarkable ductility of cast iron when heated to a dull red.

TABLE VI.—*The Tensile Strength of Cast Iron at Increasing Temperatures,*

Mark.	Tensile ton per square inch. Room temp. 70°F.	400°F.	500°F.	800°F.	860°F.	900°F.	1,200°F.	1,530°F.
1	17.75	16.5	16.2	—	—	17.1	7.00	2.44
2	17.8	—	16.3	18.2	—	15.8	6.9	2.41
3	13.2	11.5	10.2	—	13.6	—	5.2	—
4	12.0	—	9.9	—	11.2	12.4	4.96	—

The results of experiments are given in Table VI., and shown graphically by Fig. 16, together with the curve plotted from the figures published by Rudeloff.

It will be observed that there is a striking similarity between each iron whether a soft or high tenacity grade, or whether high or low in phosphorus, the strength falling from 200 to 500 deg. F., and rising to a maximum between 800-900 deg. F. Above 900 deg. F. the strength rapidly falls away, and is under 2½ tons sq. in. at 1,530 deg. F. (832 deg. C.), *i.e.*, between the carbide and phosphide change points even in the strongest and toughest irons.

These experiments, whilst by no means complete, enable a better understanding of the effect of temperature on the strength of cast irons. They show off the limitation of this material for internal combustion engine parts where high temperatures are encountered unless provided with a suitable arrangement for the dissipation of that heat. They explain the irregular behaviour of cast iron when used for press tool and die work, and the breaking down of furnace castings, firepans, stove grates, kiln-stirred blades and ingot moulds. Together with a knowledge of the stretching capacity of cast iron they enable the designer and foundryman to predict the distribution and magnitude of the stress in a casting of complicated form, and furnish a working knowledge of the strength of any portion of a casting at the various stages during cooling in the mould, thereby enabling the necessary precautions to be taken in selecting the right time to release either mould or cores, and when to remove chills without endangering the casting in any way.

The Institute of Metals.

The Relation of the Elements.

Professor Sir Ernest Rutherford, F.R.S., delivered the twelfth annual May lecture before the Institute of Metals on May 3, at the Institution of Mechanical Engineers, Westminster. Mr. Leonard Sumner, M.Sc., President of the Institute, was in the chair.

Sir Ernest Rutherford said that very rapid strides in the growth of our knowledge of the constitution and relation of the elements had been made in the last decade. It had become clear that the atoms were electrical structures of the same general type, consisting of a minute but massive charged nucleus surrounded at a distance by a distribution of negative electrons. The work of Moseley had shown that an unexpectedly simple relation existed between the elements. Apart from its mass, the properties of an element were defined by a whole number which represented the charge on the nucleus and the number of the outer electrons. This number also gave the ordinal or atomic number of the element arranged in order of increasing weight. All the known elements were defined by numbers starting from 1 for hydrogen and ending at 92 for uranium, and only a few numbers were missing. The discussion of the structure divided itself into two parts, one the laws controlling the position and movements of the outer electrons, and the other the constitution of the nucleus. After reference to the recent remarkable theories of Bohr to explain the distribution and motion of the electrons and the origin of the periodic variation of the properties of the elements, attention was directed to the structure of the nucleus which was of great complexity in heavy elements. The evidence derived from a study of the disintegration of the radio-active elements showed that the nucleus contained both helium nuclei and electrons, but no sign of the emission of hydrogen nuclei had been observed.

The atoms of the elements were very stable structures, and in order to break them up it was necessary to use concentrated sources of energy to overcome the powerful forces holding the nuclei together. The most suitable agent for attack was the swift alpha particle from radium. The atoms were bombarded by a stream of alpha particles and occasionally one of the latter passed close enough to a nucleus to effect its disruption. Experiments made by Dr. Chadwick and the speaker showed that in this way swift hydrogen nuclei were liberated from the atoms of nitrogen, fluorine, sodium, phosphorus and aluminium, but the amount of disintegration was on a very minute scale.

It seemed clear that hydrogen nuclei were constituents of the nuclei of these atoms, and were in all probability satellites of the main system. It was believed that the helium nucleus was a secondary structure built up of four hydrogen nuclei, and that consequently the nuclei of all elements consisted ultimately of an ordered structure of hydrogen nuclei and electrons. The arrangement of the parts composing the nucleus and the forces operative were quite unknown, and the difficulties of direct attack on this problem of nucleus structure were very great.

THE IRON AND STEEL INSTITUTE.

ANNUAL MEETING IN LONDON.

The Annual General Meeting of the Iron and Steel Institute was opened at the Institution of Civil Engineers, Great George Street, Westminster, on Thursday (May 4). Dr. Arthur Cooper, in the absence of Dr. Stead, through illness, occupied the chair at the outset.

Mr. C. H. Ridsdale and Mr. William Cross were appointed scrutineers of the ballot for the election of Officers and Council for the ensuing year, and later reported that all the candidates had been duly elected.

Mr. Francis Samuelson.
(President of the Iron and Steel Institute.)

The Secretary (Mr. G. C. Lloyd) read the Report of the Council for 1921:—

Report of Council.

The Council of the Institute, in their Report on the proceedings and work of the Institute and its progress during the year 1921, state that during the year 139 new members and 27 associates were elected, and 7 associates were transferred to full membership. The total membership of the Institute on December 31, 1921, was thus as follows:—Patron, 1; Honorary Members, 7; Life Members, 79; Ordinary Members, 2,085; Associates, 56; total, 2,228. Sixty-two members resigned their membership, and the names of 30 members were removed from the register in consequence of the non-payment of their subscriptions. During the year the deaths of 32 members have been reported to the Council.

Andrew Carnegie Research Fund and Memoirs.—A number of applications for grants were received during the year, and the following awards were made:—

Dr. L. Aitchison, Birmingham, £100 to assist him in carrying out an investigation of the low apparent elastic limit in quenched and work-hardened steels, with particular reference to fatigue strength, proof stress, and constitution.

Professor C. O. Bannister and Mr. A. E. Findley, Liverpool, £100 jointly to enable them to investigate the mechanical properties and heat treatment of very-low-carbon high-chromium steels.

Mr. F. C. Langenberg, of Watertown Arsenal, United States, £100 for the purpose of carrying out a research on impact testing.

Mr. J. N. Greenwood, Sheffield, £50 to carry out a research with a view to obtaining optical data on steels and steel-making materials to enable corrections to be made to temperature measurements of molten steel taken with an optical pyrometer.

The Chairman, having moved a cordial vote of thanks to Dr. Stead for his work as President during his year of office, which was carried unanimously, proceeded to induct the new President into the chair. Mr. Samuelson, he said, was so well known that very little introduction was needed. As most of the members knew, he was the son of the late Rt. Hon. Sir Bernard Samuelson, one of the most important ironmasters of the last century. Sir Bernard was one of the promoters of the Cleveland iron industry, and one of the first to erect blast furnaces in Cleve-

land. He was also one of the founders of the Institute, and became President just 39 years ago. Therefore it was exceedingly fitting that his son should follow in his steps.

Mr. Samuelson then took the chair amid cheering, and thanked the Members for his election.

Presentation of the Bessemer Medal.

THE PRESIDENT said it fell to his lot as his first duty in the chair to honour the great Japanese metallurgist, Prof. Kotaro Honda, whose devotion to research was well known to metallurgists in all countries. Prof. Honda's work had been largely concerned with the magnetic properties of iron and steel. He established the theory of molecular magnetism, based on the measurement of the amount of change of the volume in the steel when magnetised, and his researches led to the discovery of one of the best materials for the manufacture of permanent magnets. He had also directed extensive investigations with the object of elucidating the nature of the A2 transformation of steel. Prof. Honda likewise enjoyed a wide reputation as an instructor and teacher of metallurgical science. Due to his efforts the great Iron and Steel Research Institute, with its well-equipped laboratories, was founded by him at Sendai University some years ago. Unfortunately, Prof. Honda had found it impossible to make the long journey from the Far East to receive the Bessemer Medal in person, but the Secretary of the Japanese Embassy (Mr. Tokuwaga) had kindly accepted an invitation to be present and receive the medal on behalf of Prof. Honda. He had very great pleasure in presenting the medal to Mr. Tokuwaga, and asked him to convey the best wishes and congratulations of the Institute to Prof. Honda.

MR. TOKUWAGA, on behalf of Prof. Honda, expressed his thanks for the honour conferred upon him, and especially thanked the President for the part he had taken in the presentation.

THE PRESIDENT then delivered the following Presidential address:—

Presidential Address.

In making a few suggestions as to what seems to me to be the probable future trend of blast-furnace and steelworks practice, I must apologise to steel-makers if I treat as still open certain questions which they, with their superior knowledge and experience, consider settled and closed. Few questions are really definitely closed, and, as the conditions of working are continually changing, it is always as well to revise our views from time to time.

Chemical and Mechanical Tests.

The first question—first, because it governs many of the conditions—is one that steel-makers may be able to answer, but this answer may not be acceptable to the purchasers of their steel. It is, to what extent should finished steel be subjected to chemical as well as to mechanical tests? I would not go so far as to claim that chemical tests or chemical specifications should be entirely abolished, because it is possible that impurities might exist so distributed in the mass of metal that, whilst the particular parts selected for mechanical tests might successfully pass the ordeal, there might be parts which escaped the tests, but which were really dangerously defective. On the other hand, it might be said that this would be a defect of inefficient sampling, and such parts might just as easily have succeeded in evading the chemical as the mechanical test.

Without going to the length of proposing the abolition of the chemical in conjunction with the mechanical tests, it may be that it would be possible at least somewhat to relax the severity of the chemical specifications, when the mechanical specifications are perfectly met. This opens up the question of whether the present chemical specifications are or are not unnecessarily severe, and whether the limits for phosphorus, sulphur, copper, and arsenic in particular are or are not unnecessarily low. Arsenic and copper in moderate quantities have been shown by Dr. Stead, in his papers read before the Institute in 1895 and 1916, to be quite harmless in steel. In so far as the specifications are, or may be, too low, they do or may cause unnecessary cost in working, and greatly restrict our sources of supply, giving an artificial value to certain very pure materials and unduly depressing others, somewhat less pure, to the manifest advantage of the few and to the very great detriment of the many, and to the loss of the world in general, and perhaps more particularly of this country, which is unnecessarily debarred from using the whole of its resources in the most advantageous way.

As an example, certain ores, which under present conditions can only be used in the basic process, might perhaps, under more liberal specifications, be used in the acid process. In some cases their cost would be prohibitive for use in the basic process and, if not used in the acid, they could not at present be used at all.

There seems to be considerable variety in the amount of phosphorus and sulphur allowed in rails by various railway companies, the lowest being 0.04 per cent. for either element, and the highest, the British Standard Specification for bull-headed rails, being 0.075 per cent. for phosphorus and 0.08 per cent. for sulphur. Two railways, over whose lines many of the same trains run, vary by 0.02 per cent. for both elements—0.05 in the one case and 0.07 per cent. in the other—with practically the same carbon. If one of these railways be not endangering the lives of its passengers, the other is needlessly increasing the cost of making steel rails and restricting the use of certain ores.

Is it not the case that foreign steels are imported into this country with higher limits than are allowed by our own authorities, and that no failures can be shown to be attributable to this fact?

Future of Processes.

The next two questions deal with the future of processes. Is it certain that in cases where the materials from which the pig-iron has perforce to be produced are at once sulphurous and siliceous, and where it is difficult, if not impossible, without unreasonable cost, to make pig-iron low alike in sulphur and silicon, it would not pay to make the iron low in sulphur and somewhat high in silicon, and to get rid of much of the silicon by means of a more active mixer than those generally in use before the iron goes into the open-hearth furnace? The advantage in the blast furnace is clear; it is cheaper to make foundry than forge iron. The difficulty of making an iron that suits the steel-makers is great, and a furnace that is easy to work is an economical furnace.

Is it not probable likewise that large quantities of ores containing phosphorus only a little above the present and the possibly more generous future limits, will be used to make pig-iron to be treated by modifications of the basic process, such as a preliminary treatment for removal of phosphorus in a basic-lined mixer, the steel being finished in an acid-lined furnace?

If ores could be dealt with in some such way our resources would be extended, and there would be a tendency to equalise their values either by cheapening the purer ores or by giving the less pure such increased value as would enable some of them to come into a market from which the discrepancy between their value and the cost of winning them at present excludes them.

It does not seem probable that the electric steel furnace will be used to any large extent in this country for the ordinary conversion of pig metal into steel. Its principal use will rather be to replace crucible smelting, further to refine steel previously made in a commercial furnace, or for other very special purposes. There does not appear to be much scope, at home, for electric smelting furnaces. Such processes are more suitable for countries where water power is cheap and fuel dear. The cost of the electric power and the fuel used must together not exceed the cost of the less pure fuel an ordinary blast furnace would use per ton of pig-iron.

Direct Processes of Steel-Making.

On this subject Mr. Harold Wright has written to me as follows:—

"There are serious practical difficulties to be met in the direct production of iron or steel from ore upon any large commercial scale. (1) It is not possible completely to reduce all the iron oxide to iron, because under conditions of direct reduction iron oxide forms a basic

silicate with the silica present in ore and fuel, involving loss of iron and other serious troubles, should the product be molten. (2) When the ore contains much gangue, a balling-up process must be applied to the product, otherwise the gangue requires fusion, which can be better done in a blast furnace. (3) The ore, and the fuel used direct, must be pure. (4) All the ore and fuel must be finely ground and intimately mixed. (5) The heating of large masses of mixed finely-ground fuel and ore presents considerable difficulty in large-scale operations. (6) If the product be not fused, but have to be balled up, the difficulties in producing the large masses of steel forming common requirements to-day are almost insurmountable.

"All practical steel-makers agree in avoiding to the utmost any considerable percentages of iron oxide in the slag at every stage of commercial steel manufacture, and will readily understand the bearing of one difficulty stated, viz., the manufacture of a satisfactory molten product beneath a slag high in iron oxide. In open-hearth practice control of iron oxide in the slag is necessary on every account, but especially subsequent to tapping to avoid casting troubles."

Blast-Furnace Problems.

Most of the very numerous problems relating to the blast furnace have been to a very large extent worked upon, but probably very few, if any, of them have been completely solved. The largest problem, and one that covers the whole field, is the question as to what extent the known deficiencies of British plants suggest a policy of scrapping and rebuilding, and, on the other hand, to what extent we can improve matters with a moderate expenditure of capital. The following is an example of the sort of question that confronts us when considering the advisability of complete or partial scrapping and rebuilding of a plant. The figures are arbitrary, and are in no way supposed to represent facts; they must be considered as symbols only.

Assume a plant of five furnaces making an average of 800 tons of iron per furnace per week at a profit of 1s. a ton. Assume that by an expenditure of £100,000 the iron can be made for 8d. a ton less, and that 200 tons more can be produced per furnace.

I assume that it is not worth while to expend large sums of money on new plant unless you think you can see a gross return of 20 per cent.—5 per cent. being interest on your capital, what you like for depreciation, and the remainder being the profit that makes your enterprise worth while. This has been the rough figure I have always worked upon when I have had such a decision to make. I find an American author demanding a gross 25 per cent. instead of my 20 per cent. The difference would save many plants in this country from the scrap-heap.

You require thus to make a gross profit of £20,000. The result you are to get is:—Original output, 208,000 tons; additional output, 52,000 tons; total new output, 260,000 tons, which at 1s. 8d. profit = £21,666. From this you have to deduct the profit you were getting before, which was 280,000 tons at 1s. = £10,400. The net result of your expenditure of £100,000 is that you get an additional return of £11,266 per annum—11¼ per cent. on your outlay, which is quite inadequate. In this country the profit on pig-iron making is not large. If the profit were much larger, that would be a factor in favour of the scrapping policy. If, for example, the profit had been 5s. instead of 1s., the yield on the additional output would have been larger by 52,000 times 4s., or £10,400, which would have turned the scale in favour of the scrapping policy. At 1s. profit, however, it would not pay, unless there were some object to be attained which is not expressed in the figures.

In the foregoing calculations I have assumed that the saving, 8d. a ton, has been correctly estimated, and that it (and no more saving) applies to the whole new output. But it may happen that the 8d. saved by better working has been reckoned without allowing for the saving per ton in standing charges due to increased output; or it may be that not sufficient allowance has been made for difference, present or prospective, in cost of repairs and renewals between the old and the new plant. On the other hand, I have also assumed that the increased output is a real increase. If there be no outlet for increased output, and it be only a case of producing the same amount in fewer furnaces, then the credit for increased output disappears.

Ore Supplies.

There is no more vital problem than that of the future of our ore supplies. Without underrating the great importance of the hematites of the north-west coast of England, especially in the Egremont district, the fact remains that the non-phosphoric ores of Great Britain are limited in quantity, and that the greater part of our production must come from the smelting of the phosphoric ironstones of Cleveland and the Midlands, and of imported ores, non-phosphoric or phosphoric. The development of a great part of the ironstones of the Midlands has been recent, and the reserves may be taken to be very large. The Cleveland district, on the other hand, has been extensively worked, although there remain large quantities of stone, which deteriorates rapidly in quality as the workings go farther to the S.E. The length of life remaining to this field is problematical, but it may be greater than is generally supposed; in the first place, because it is a common experience that mines last longer than is expected; and, in the second place, because it is not improbable that means may be found in the future of successfully smelting stone that is at present thought to be too low in quality. This may come about through the use of new methods of treating the stone before it goes to the furnace, or through metallurgical processes as yet unknown; but it seems more probable that the solution will be found in an extension of the practice already existing of mixing with the native stone a proportion of richer foreign material. If an ore sufficiently high in iron and low in silica is used, a few cwts. will bring up a very inferior stone to the level of a fair Cleveland mixture.

Separation of shale and pyrites and small stone containing much dirt by means of picking belts and screens will have to be carried to the utmost economical limit.

The question of the economical result of less rigorous cleaning of the stone at the Spawood mines was recently investigated. The total tonnage of stone worked at the time was 8,159 per week. This consisted of:—Clean stone sent to furnaces, 5,929 tons; shale (large and small) sent out, 824 tons; "sulphur," "black hard," etc., sent out, 410 tons; shale left in the mine, 996 tons. The effect of sending forward the 824 tons of shale now removed by screens and belts was considered. It was found that the mine would save in actual cost £27 per week, and, allowing for the equivalent of clean stone contained in the rejected material, might be further credited with £154 for the value of this material, making a total gain to the mine of £181 per week. The loss at the furnaces was reckoned at £691 per week, showing a net loss to mines and furnaces, taken as one concern, of £510 per week, or over £25,000 a year, whilst the net loss on the additional material sent out was 12s. 4d. per ton.

These figures make one consider whether it is possible to carry the cleaning of this kind of stone still farther; and whether, in dealing with other classes of ores, it might not in some cases prove economically sound to sacrifice considerable quantities of iron in improving the working condition of certain ores by screening out dust or by other, at first sight wasteful, means.

One's mind recoils from the idea of wilfully throwing away iron, but it is to be remembered that the unit of iron in ore, and especially in ore that has borne no carriage charges, has a very different value from the unit of iron in pig-iron, and that this value varies with the cost of smelting the particular unit, and that all these values are relative to values of fuel and values of labour. I am assuming that the iron is actually lost. It may not be lost; it may be saved by using some one or other of the agglomerating processes. Further, especially in the case of plants where the most modern processes and apparatus are not in use, much of the iron saved by not screening might be lost, and lost in a manner very detrimental to the working of the plant, in the flues, in the stoves, and under boilers.

The problem of home resources seems a fairly simple one. They will be developed as required in the natural course of events. The ores will lie in the earth till we want them; nobody can take them away from us. Can the same be said of the security of our supplies of imported ores? These are for the most part the property of other nationals, and we are subject to the competition of all the world. At present there is no positive dearth of imported ores, but there is not the facility of getting ample and constant supplies of good ore of even quality that there was some years ago, and blast-furnace owners have now to a great extent to take, not what they wish to buy, but what the mine-owner wishes to sell, and, using complicated mixtures of many ores, to play off the virtues of one ore against the vices of another. In the case of such mixtures they may find themselves very dependent upon the corrective use of some particular material, and, if this fails them, as does happen at times, they may not be able to find a substitute, and their quality or their costs suffer accordingly.

I have counted fifty-eight names of imported ores that have been tried of recent years in the Newport furnaces. This condition of things has, quite apart from any difficulties caused by the war, shown a continual tendency to grow worse, and the difficulties are more likely to increase than to diminish, especially when a return to more settled economic conditions in Europe causes a greater competition for the best ores. The future of our industry would be more secure if a greater proportion of the iron ore resources of the world were under our own control.

Our principal foreign sources of supply at present are the Bilbao ore-field, which is of much less relative importance than formerly, the best ore having become scarce and the average level of quality having fallen considerably: Scandinavia, where we have been in the past, and may be in the future, liable to keen competition from other nationals; parts of Spain other than the Bilbao district, the ores being variable in quality, not on the average as suitable for our purposes as were in their best days the Bilbao ores: North Africa, that is to say, Algeria, Tunis, and Morocco, where there are some very good ores—some that, while not individually perfect, are complementary one to another and can be mixed advantageously, and some that, whilst useful, cannot be considered of very high class; but the total supply of these districts is, so far as is known, by no means inexhaustible.

It is not likely that we shall get much ore from Russia, as, when she recovers her economic position, she is likely to consume it herself, and in any case Central Europe seems a more likely field than Great Britain for her exports, if any. No other European countries seem likely to supply us with ores in any considerable quantity.

There are large quantities of a medium-grade phosphoric ore in Newfoundland; this ore has not hitherto been imported on a very large scale into Great Britain. It seems probable that it will in the main be consumed on its own side of the Atlantic, though there are indications that it may be brought into this country and into Germany in larger quantities in the future than in the past.

We may expect the United States to consume their own enormous supplies.

The ore of Chile, so far as known, is very rich but refractory, and is more likely to continue to be used in the United States than to be brought to this country.

Brazil has vast supplies of ore of the very finest quality, besides still vaster quantities of good second-class ores. The Brazilian ores are situated at a considerable distance from the coast, and heavy capital expenditure on railway and port works will have to be incurred before they can be brought into the market.

India and Australia are more likely to consume their own ores than to export them.

There are iron ores in various parts of Africa other than the Mediterranean countries; but so far, I believe, there is no evidence to show that any of these ores are at once of such quality and so favourably situated that they could be economically exported to Great Britain.

France probably has at present a surplus of ores, both in the North-East and in the North-West. The ores of the Eastern side are hardly rich enough in iron to bear the cost of transport to the furnaces of Great Britain, unless means can be found of considerably reducing this cost. Those of the West are richer, but even they are for the most part not sufficiently superior to our own ores to make it probable that there will be, under present conditions, any very considerable importation of these ores into this country.

But a time may come, if and when the Kent coalfield is further developed, when a big steel industry will be established on either side of the Channel, based on an interchange of the ores of Normandy and Brittany, and perhaps also of the Eastern field of France, with the coal of Kent.

Treating Ores.

Many ores are capable of improvement by treatment either at the mines or at the furnaces, the improvement consisting of the removal of useless or objectionable matter; it is obviously preferable that the improvement should, if practicable, be made at the mines, as the cost of loading, carrying, and unloading the rejected material is thereby saved. If the treatment at the mines consists in the agglomeration of fines by briquetting, sintering, or other such processes, the product should be such that it will bear carriage without to any serious extent breaking up into fines again. But in many, probably in most, cases the cost of fuel at the mines will be such as to prevent the work from being carried out there, in which case it will have to be done at the furnaces, or possibly, by some arrangement between firms, at a central station. If the fines are the result of crushing and separating, magnetically or otherwise, that part of the work will, of course, be done at the mines. Much of the improvement may in other cases be attained by simpler processes, such as hand-picking, washing, and screening.

This work would probably be more thoroughly done than is sometimes the case if our scales of additional payments and deductions for iron, silica, etc., above or below a fixed standard were more elastic and were made to vary with the prices of pig-iron and coke, or, what comes to much the same thing, but would be simpler in action, with the price of the ore itself.

Other ores require calcination: whether this is done at the mines or at the furnaces will depend mainly upon whether the distance between them is great or little. The carbonates of the north-west of France are calcined at the mines in simple kilns not altogether unlike our Gjers kilns, and still more like what our Gjers kilns were before, in order to have hoppers at the bottom, we sacrificed air space and central air admission. Their consumption of fuel, anthracite duff, and coke dust is about 22 to 23 lbs. to the ton of raw ore; they are worked with a low-pressure forced draft, the pressure varying from about 2½ to 10 in. of water. Is it not probable that a light forced draft would have a tendency to improve the regularity of burning in the case of Cleveland stone? And is it not the case that kiln power and kiln design have fallen behind in relation to the other improvements and the increased output at our Cleveland furnaces?

It is not necessary for me to go into the various processes of briquetting, nodulising, and sintering. The subject has been treated by many writers, and was fully dealt with in 1917 in a Paper read by Messrs. G. Barrett and T. B. Rogerson. It is probable that reductions in the cost of plant and operation, and improvements in the perfecting of the product, will gradually be made by those who are actually engaged in working the various processes. Those who are not working them might do well to consider whether any of the materials they are using could advantageously be subjected to one or other of the agglomerating processes, or whether there are materials which they are not using, but might advantageously use, if so treated.

It would be very interesting if some chemist would undertake analyses of the dead-small in most of the materials that go into the blast furnace and ascertain in which cases its removal would enrich, and in which impoverish, the residue.

Handling Ore Supplies.

It is of the greatest importance that our means of dealing with foreign ores in our ports should be improved, and, in the event of any large individual sources of ore supply becoming available.

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and in case our national production of iron and steel should increase upon its present relatively low figures, it may become even more important than it is now. Our facilities for quickly unloading large ore ships are very far from being all they should be, and compare very unfavourably with those that exist in such ports as, for example, Antwerp and Rotterdam. Unless they are greatly improved we shall fall even farther behind in the race than we are at present.

We may not be able to reach the standard of the American Lake ports any more than we can equal the vast and homogeneous loads of the American ore railways, but, until we can provide deep-water berths where large ships can lie afloat at all states of the tide, and until these berths are equipped with appliances for unloading ships with the greatest possible speed, and until the spirit of our labour is such as to enable us to reap the fruits of our expenditure on these objects, we shall have to pay high freights and shall be thereby hampered in our efforts to make full use of some of the most important of the possible sources of our ore supply.

This vitally important matter of improved port arrangements is only partly in our hands. Perhaps by combinations, complete or partial, of large interests, our power to effect improvements may be increased.

Valuation of Materials.

The last problem I have to suggest for your consideration is that of the valuation of materials, especially of ores, coking coals, and cokes.

I have touched upon the commercial valuation of ores, in which, I think, there is room for improvement, because the difference in value between clean and dirty ore is not sufficiently felt by the mine-owner, where he is not also the user of the ore; and this has an actual detrimental effect, leading, as it does, to the wasteful transportation and the wasteful smelting of matter that ought not to have been shipped. Otherwise the inaccuracy of commercial valuation does not do very much harm. It accentuates the difference between the man who knows his business and the man who does not, and so has an eugenic effect tending to the elimination of the unfit. But more scientific valuation for his own purposes is requisite if the user is to make the best use of the materials at his disposal. The user's valuation will give the value to him, which may be greater or less than the commercial value; it will not be absolute, but relative; an ore or a coal may be worth less than the normal used by itself, but, mixed with another ore or coal of equally subnormal value, the resulting mixture may be of standard quality and standard technical value. But universal applicability will affect commercial value, and so what A cannot or does not know how to use should be cheap to B, who can and does.

In the case of ores the valuation would not depend solely upon the quantity of certain elements, but also upon questions of mechanical condition, dust loss, reducibility, and special applicability to the user's conditions. If the ore necessitated the use with it of a costly ore, that fact would reduce its value to an extent which could be exactly calculated. If it enabled the use of a cheap ore, it would increase the value in the same manner. In every case it is a question not of the value of the ore absolutely, but of its value relatively to the user's conditions. The same sort of valuation should be applied to cokes, coking and other coals, fluxes, refractories, and all other materials. Where this sort of close valuation is carried out, it will probably be found that, except in cases where the market value of a good material is unduly enhanced by tradition and want of exact knowledge on the part of the user, the superior materials are sold at less and the inferior at more than their relative value. This comes about because, average human nature being what it is, there is more demand for the low-priced than for the expensive article.

Sir William Ellis proposed a vote of thanks to the President for his address, alluding to it as one of the most human addresses the Institute had had from a President. The President had been very considerate in making suggestions which would be helpful to many who had difficulties with blast furnaces.

The motion was carried with acclamation, and The President briefly expressed his thanks.

Canadian National Exhibition.

The forty-third Annual Canadian National Exhibition will be held at Toronto from August 26 to September 9, 1922.

These exhibitions, which cover a wide range of industries and trades, are undoubtedly an excellent medium through which Canadian buyers and the public can be afforded an opportunity of familiarising themselves with the products of the United Kingdom industry. The attendance at the 1921 exhibition reached the high figure of 1,242,000; the exhibits thus secured a remarkably wide publicity, in addition to the unique attractions of the Exhibition as a medium for trade. It is, further, interesting to note that the Dominions Royal Commission, in their Fifth Interim Report, paid a high tribute to the success of the Canadian National Exhibition and emphasised the desirability of increased participation by United Kingdom manufacturers.

Notwithstanding these advantages, the number of United Kingdom firms maintaining stands at last year's exhibition only approximated thirty—far short of the number of American and Canadian participants. Despite this small representation, the interest displayed and the inquiries made by Canadian visitors gave ample evidence that there are excellent opportunities awaiting the British exporter to Canada.

United Kingdom firms desiring to secure space at the forthcoming Exhibition should apply immediately to the Secretary, Canadian National Exhibition, Lumsden Building, West Adelaide Street, Toronto.

It is, of course, realised that not all United Kingdom firms who might be desirous of participating would consider the expense of maintaining stands warrantable in the present financial situation. In this connection a Bureau of Information will again be maintained at the Exhibition by His Majesty's Trade Commissioner Service in Canada, at which trade literature, small attractive posters, samples, etc., may be displayed. In 1921, for instance, among a number of such exhibits was a showcase containing excellent samples, typical of the cotton industry, ranging from the seed to the finished product. This exhibit, which was sent by the Manchester Chamber of Commerce, attracted great attention and much favourable comment.

While, therefore, it is desired that as many United Kingdom firms as possible should take space and maintain separate exhibits, His Majesty's Trade Commissioner at Toronto will be glad to receive from manufacturers, merchants, Chambers of Commerce, Port Authorities, and other commercial or industrial organisations who cannot take space, any such literature or small samples, which will be distributed from or exhibited at, the Bureau of Information free of charge.

Catalogues, etc., of the following lines are especially mentioned as being useful:—

Textile machinery, industrial machinery, including pulp and paper-making machinery and supplies, mining machinery and supplies; electrical machinery and appliances; shipbuilding machinery and supplies; mining machinery and supplies; heavy vehicles; chemical plant, etc.; scientific instruments, and sugar machinery.

Catalogues, samples, etc., should be sent direct to His Majesty's Trade Commissioner, 24, West Adelaide Street, Toronto, not later than June 30. In their own interests, as well as in the Trade Commissioner's, United Kingdom firms forwarding literature or samples are recommended to exercise special care to ensure that the requirements of the Canadian Customs Authorities are met, and that their consignments are despatched in good time. Disappointment and inconvenience have been caused on previous occasions by failure in this respect. Although samples may be considered by the shippers to be of no commercial value, and consequently are not invoiced, this view may not be taken by the Customs appraiser, and the correct form of invoice, properly certified, should be forwarded in respect of all consignments of samples to avoid difficulty.

Leaflets issued by the Exhibition authorities, Canadian Press cuttings, copy of correct form of invoice, and other particulars, can be examined by United Kingdom firms interested, on application to the Department of Overseas Trade (Canadian Section) 35 Old Queen Street, London, S.W.1. (Ref. D.O.T. 4985/F.B./P.N.).

Shaft Couplings.

By S. G. Smith.

Sometimes the plainest and apparently the most simple castings to make are more difficult than intricate ones. Amongst these are half couplings for turbines. Any castings which are required to be machined all over and also bored are not easy to make satisfactorily. To obtain this, continual supervision and care in the foundry is necessary. In engineering works manufacturing turbine engines, generators, etc., in large quantities, the inspection on couplings is very severe and exacting. These castings are rejected if the least accumulation of dirt, pellets, or small cavities appear on any part of the outside surface of the casting. If the bore shows any appearance of a draw, or spongyness in the metal, it is also considered to be a waster. Half couplings vary in outside dimensions from a few inches to 24 inches, and in weight from a few pounds to ten cwt. The diameter of the centre core may be sometimes large or small, with the same outside dimensions, which fact often increases the difficulty of making the surface of the bore absolutely sound and dense. This variation in diameter of core is due to the size of the shaft required for the couplings. This brings in many difficulties, because the variation in the size of shaft is from three to six inches, with the same outside dimensions, hence it is not surprising when the small diameter core is used, that the increased bulk of metal would be difficult to make sound.

The author's attention was directed to these particular castings on account of the high percentage of wasters, which were, including large and small couplings, of serious dimensions. The scrapped castings were chiefly due to dirt from various causes on the outside when machined, and porosity in the bore. The defects in both large and small couplings were very similar.

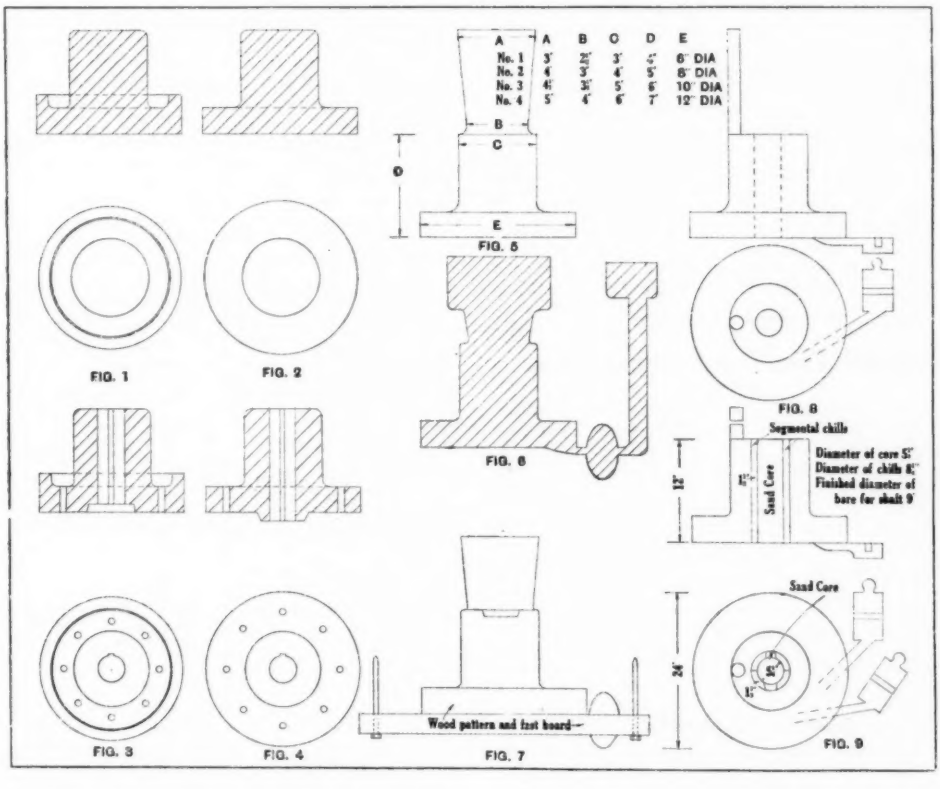
Figs. 1 and 2 show the half couplings as shipped from the foundry, and Figs. 3 and 4 illustrate the same after machining.

At the outset the writer insisted in all cases that the diameter of shaft should be ascertained for all couplings. This information gave the foundry a free hand to cast the couplings solid, cored, or otherwise. Consequently the small couplings, up to 6 in. diameter on the smallest outside dimension, were cast solid, with a feeding riser in the centre.

The sizes of feeder necessary to ensure soundness when properly fed, are set out in Fig. 5. All dimensions are approximate, but are sufficiently accurate for practical working purposes. The smallest of these, No. 1, Fig. 5, will take not less than five minutes to feed sound, whilst the largest, No. 4, will take not less than fifteen minutes. As a rule these are choked up in less than half the time mentioned, with the result that they will be scrapped from porosity in the bore.

It may be interesting to note that half-couplings corresponding to the above dimensions are moulded from a follow-board; that is, the pattern is attached to a plain board and turned over. The method now adopted to eliminate dirt and dross when pouring is by means of a swirl, egg-shaped, dirt-trap, runner-gate. Fig. 6 shows such a contrivance, and the feeder attached to the casting.

Fig. 7 illustrates the pattern and turning-over



board ready for ramming the box-part, this work being carried out by semi-skilled hands.

Large Couplings.

Coming now to the larger half-couplings, these are loose patterns moulded in the ordinary way by skilled men, but instructions should be given to cast always the smallest outside diameter upwards. The largest of these couplings are usually made in dry sand. There is no good reason why these cannot be made in green sand. It is simply a matter of a suitable facing sand, and reasonable ramming. The casting is as simple as a brick, as the mould requires very little venting. The only advantage a dry sand mould has over a green sand mould in heavy castings is that a cleaner skin is obtained.

Heavy couplings naturally require more feeding and a denser iron than the light couplings, unless some other means are adopted to ensure this. The author has on several occasions witnessed two skilled men feeding a half coupling weighing not more than twelve cwt. for thirty minutes with

two large feeders. Formerly these were fed with one large feeder, but in both cases a porous bore was the result. With the medium-sized couplings, the element of uncertainty regarding soundness is so great that the author came to the conclusion that some other method, or a remedy, must be found.

As indicated, the diameter of shaft for all couplings should be ascertained, and with this information available the plan adopted was that the shaft of 4 in. dia. was supplied with a solid chill or densener in place of a sand core. A quarter of an inch either side must be allowed for boring. The result is usually satisfactory, the bore giving a highly-finished, dense surface. No attempt need be made to taper the chill and knock it out, as it should be made almost straight, allowing just sufficient taper for draught when moulding. The operation of boring the solid chill out takes only a few minutes longer than the usual operation of boring when a sand core is used. This method, if persevered with, gives every satisfaction.

To apply this method to the bore of large shafts, say up to 9 in. dia., is a different proposition, but the writer designed for this purpose a collapsible chill, which gave the same desired result. This set of chills only requires two small patterns, the castings from which encircle a small sand core. When the sand core is knocked out of the castings, the chill segments fall out. The chill segments are usable over and over again.

This method not only gives a dense, clean, sound bore, but eliminates the feeding altogether in the medium-sized couplings, and minimises the feeding considerably in the large couplings—a little only being done as a precautionary measure for soundness in the heavy section around the outside of the bore.

Fig. 8 shows the solid chill, or densener, and Fig. 9 shows the collapsible chill, or densener. The dross trap used for the loose patterns is somewhat different from the egg trap used on the follow-board. The temperature of the iron suitable for pouring couplings should be medium; that is, not dazzling white, nor yet dull or stiff.

National Foundry Competitions.

There are to be held at the International Foundry Exhibition, which opens at Bingley Hall, Birmingham, on June 15, some interesting practical foundry competitions which have been organised by the Birmingham Chamber of Commerce, the Institution of British Foundrymen, and the British Cast Iron Research Association.

The competitions are open to all foundry employees, ex-Service trainees, and technical school students in Great Britain under 21 years of age on May 15, 1922 (except in Class C), male or female, whether in employment or not. Neatness, finish, initiative, and time taken in the work will be the basis of awards.

The conditions are as follows:—

Schedule of Competitions.

Class A.—For making the best core in one of the following sections (see Condition No. 6). *Section* 1.—For light castings. A choice between a radiator core and a water-cooled cylinder core, which are to be oil-sand cores. Both first and second prizes, value £3 3s. and £2 2s. respectively, have been presented by the National Light Castings Association. *Section* 2.—For medium castings. In this section either a pipe work core or an arm core and tooth core for wheel can be made. Two prizes, the first of three and the second of two guineas, are being presented by the Right Honourable Lord Weir. *Section* 3.—For heavy castings. Here a choice is given between a steam port core for cylinders or pumps and a strickled core. Prizes of a similar character are being presented by the British Engineers' Association.

In all classes the winner of the first prize in each section will also receive a diploma from the Birmingham Chamber of Commerce. A consolation prize of a foundry technical book will be given for the entire class. A competitor can only compete in one section in this class, and must state the section in which he or she wishes to compete.

Competitors *must provide their own tools*, but the following will be provided by the committee: Core boxes, core binders, wire for core irons and means for its bending and cutting, brushes, shovels and necessary sands, etc.

Class B.—For making the best mould in each of the following sections (see Condition No. 6). *Section* 1.—Floor moulding. For this the Right Honourable Lord Weir is giving three prizes of five, three and two guineas. *Section* 2.—Two-part work moulding. Prizes, as in Section 1, are being presented by the Worshipful Company of Founders. *Section* 3.—Three-part work moulding. Prizes as in the two previous are being presented by the Institution of British Foundrymen.

Competitors *must provide their own tools*, but the following will be provided by the committee: boxes, riddles, brushes, necessary sands and water, etc.

Class C.—For making the best pattern to a blue print design to be supplied to each competitor.

The pattern to be made in best yellow pine at competitor's shop, works, or school.

Section 1 is open to all over 21 years of age, and for which four prizes of five, three, two and one guinea are being presented by Messrs. H. Lakin-Smith, F.C.A., J. E. Fletcher, M.I.Mech.E., H. L. Reason, M.I.Mech.E., and Thos. Vickers, C.E.

In Section 2, which is open to all under 21 years of age, the prizes are of five, three and one guinea, and are to be presented by the proprietors of The Foundry Trade Journal, Mr. H. Field, Birmingham I.B.F. Branch-President, and the proprietors of "The Foundry."

Section 3 is open to students at any technical school in Birmingham and in a radius of ten miles from Birmingham under 21 years of age. Two prizes of three and one guinea are being presented by Messrs. W. Waters Butler, and Thos. Vickers, C.E.

The blue print will only be supplied to such competitors who apply for same and remit 2s. 6d., which will be returned if a pattern is sent for competition. The competitor will forward his pattern to the exhibition on June 13, 1922, *carriage paid*, clearly marked as instructed on the blue print. The patterns will remain the property of the competitors. The committee will, if requested by the competitor, return same carriage forward, otherwise they must be removed by the competitor himself.

General Conditions.

(1) All entries close on May 15, and no entries will be admitted after this date. There are no entrance fees. (2) Competitor's age must be stated on application form, which will be taken into consideration when making awards. (3) Competitors can enter in all three classes of the competition, but only in one section in classes A, B and C. (4) The judges' decision in all the awards will be final. (5) The right is reserved to refuse any application and to cancel any portion of the competition if insufficient entries are received. (6) The competitions for Classes A and B will be held at the exhibition every evening from Friday, June 16, to Thursday, June 22, and also on the afternoons of Saturday, June 17, Tuesday, June 20, and Wednesday, June 21. Competitors must state when they prefer to carry out their work. Each competitor will be expected to carry out his work at the time he is advised to be present. (7) No correspondence can in any way be entertained as to any details of the work which competitors will have to carry out. (8) All entries to be forwarded to Mr. Thos. Vickers, the honorary secretary of Technical Advisory Committee, at Central House, 75, New Street, Birmingham, marked outside "*Competition.*"

The American Stainless Steel Company, of which Mr. H. Brearley is a director, who own the American patent rights in stainless steel, instituted proceedings in the United States courts with a view to stopping the Ludlam Steel Company from making and selling steel which, it was contended, infringed the patent rights held by the plaintiffs. Judgment has now been given in favour of the Ludlam Company on the ground that the process is different from that employed by the American Stainless Steel Company. It is probable that an appeal will be lodged.

Institution of British Foundrymen.

LONDON BRANCH.

Handling Repeat Jobs.

At a meeting of the London Branch of the Institution of British Foundrymen, on April 13, Mr. A. R. BARTLETT went very fully into the various ways in which repeat jobs should be tackled in the iron foundry. After emphasising the necessity of co-operation between the designer, the pattern maker and the foundryman, the lecturer explained that machine moulding was not necessarily the cheapest method, as in many cases snap flasks could more than compete. Their drawback, however, is that the amount of work a snap flask can hold is limited by the liability to bursting. After dealing at some length with pattern-plates, a short description was given of core-making machines.

The lecturer then touched upon the subject of box pins and pin holes. He advocated a standard size of pin for each size of box. These are made of steel, and all the holes, both in the pattern plates and boxes, are made to receive a hardened bush, accurately drilled, with an allowance of 0.006 in. on holes up to ¾ in., and increased slightly on larger sizes. It is better, he stated, to use only two pins on all plate work of a small type, as more are likely to get out of order much more quickly, whilst if one pin is used in the top box and one in the bottom, the box cannot be put on the wrong way round. With large work, however, three or four pins are advisable.

The advantages which modern machine moulding give are increased output, accuracy and uniformity in shape and size, no heavy pins to be removed; the perfect fitting of the boxes and the perfect drilling of the patterns, which largely eliminate tooling and mending of the moulds—a factor which in hand-moulding often causes bad joints and faulty castings.

The first attempt at mechanical moulding appears to have been the hand squeezer, which naturally only saved ramming time. The power squeezer followed, thus saving a little more time, and additionally the energy of the moulder expended on drawing patterns and setting cores. Pattern guides or stripping plates were then devised to assist in drawing patterns accurately, and more recently vibrators were constructed to free the pattern from the sand without unduly enlarging the mould.

Squeezers are divided into two definite types, one in which the press head is brought down to the sand in the moulding box, and the other in which the box is fixed to the pattern table and the whole raised to the press head, which is a fixture. A machine made by a French firm is a combination of the two. It simultaneously rams both the top and bottom parts of the mould. The pattern plate in this instance is fixed to a swinging arm on a column, the pattern being arranged on the top and bottom of the pattern plate. This is made to turn on its side, and is brought between the press head and the bottom table when required. This machine is worked by hydraulic power, and behind the arm, attached to the column of the machine, are arranged the operating valves. Additionally there is a foot valve for the purpose of bringing the two parts together. The *modus operandi* is to place the bottom box on the lifting table, then to fill it with sand to about 1½ in. above the level of the box. The swing arm, with the pattern in place, is brought over it. The top box is then placed on the pattern plate and filled with sand in a similar manner to the top box.

The operation of the valves raises the bottom box to the pattern and presses the whole mass to the top head at the same time. The pressure is kept on sufficiently long to squeeze the whole of the sand the level of each box part. The top box is then attached to the top head, the operating valves, on being reversed, allow the pattern plate to lower to its original position, and the bottom table, with the bottom box, lowers. The pattern is then slung clear, and the box parts are automatically brought together again on their pins. The boxes are clamped together and are ready for pouring. According to the lecturer, this machine is only useful for very shallow work, but it is very rapid in action.

There are practically only three methods of drawing patterns on moulding machines. In one, the pattern is fixed, and the mould is raised by means of posts attached to a frame, and operating under each corner of the box part. Another method is that in which the box part remains stationary, and the pattern is either raised or lowered according to the type of machine. The third method is that in which the stripping plate is used, and the patterns are drawn through either upwards or downwards, the mould always remaining stationary.

It has been said that a hand-ramming machine is only half a machine, but four or five times the amount of work can be turned out per day more than could be accomplished by a skilled moulder.

The jar-ramming machine is especially useful for ramming deep work. It entirely eliminates the necessity of any hand ramming. Such machines are essentially sand-packing apparatus, the sand being rammed by a series of jolts, varying with the depth of the mould and the amount of strain placed upon it. It will be found that the sand is the most dense at the surface of the pattern, and of less density below.

An advantage is shown over the usual method of hand ramming or squeezing, in that it aids the escape of gases when the metal is poured into the mould, and thus obviates the use of bent wire to a large extent. All jarring machines ram on straight vertical lines, and it follows that all patterns must be made to suit this tendency. Any overhanging parts, such as feet and bosses, must have core prints below them to the face of the pattern plate. If this is carried out correctly, any casting can be made on a jar-ramming machine up to the size limit of the machine.

The author stated that in his foundry there is working a jar-ramming machine which produces perfect moulds weighing seven tons. This machine is shockless. Work of a plain type has been rammed in a few minutes that would take two men ten hours to do by hand, obviously introducing a great time and labour saving. The advantage of a shockless machine is that it does not shake the ground in its vicinity, and work having hanging parts can be successfully carried out in the immediate neighbourhood.

On small work the jarring machine cannot compete with the power squeezer of the same capacity, except where the work is deep. No matter what type of machine is installed, it is advisable, wherever possible, to ram bottom parts and top parts alternately, for by so doing the moulds can be closed at once, with all its attendant advantages.

Speaking of turn-over machines, the lecturer stated that they were not as economical as the non-turnover, which eliminate the operation of turning and the need of clamping the box to the table to turn it. With the turn-over machine, the deep and more intricate work can be lowered from the pattern in a perfect condition, and castings having deep internal parts, such as pulley boxes are usually made on turn-over machines. As the bottom parts leave the machine in the correct position, the use of gaggers or irons can often be eliminated. This type of machine lends itself to use of stripping plates when making deep castings, having a small taper such as spur wheels of small or medium size. Large gear wheels, however, are produced with a wheel-moulding machine, where ramming is done by hand, and only the setting and drawing of the teeth being mechanically accomplished. Great care must be taken in fixing the diameter, and experience is necessary to ensure good results.

In conclusion, the author remarked that the moulding is full of possibilities. Thousands of castings can be produced before the machine requires repairing, and obviously, where quantity production is sought, it will prove itself worthy of notice, and with ordinary care will soon show a return for the initial outlay.

THE DUTCH shipbuilding yards in 1921 built and delivered 99 sea-going vessels aggregating 380,320 tons d.w. (264,498 in 1920), of which 84 were steamships aggregating 361,670 tons d.w. (239,878 in 1920), 3 motor ships of 13,400 tons, 10 sea lighters of 4,100 tons, and 2 motor schooners of 1,150 tons. Over and above this number 33 sea-going tugs were also delivered.

XUM

Trade Talk.

The imports of foreign ore at the Senhouse Dock at Maryport for April have been 3,500 tons.

Mr. W. J. Firth, tinplate agent, formerly of 29, Great St. Helens, E.C.3, has removed to 626, Salisbury House, London, E.C.2.

Harvey, Wilson & Company, Limited, 55, Bath Street, Glasgow, have been appointed agents for the Ailsa Craig motor launch engines.

Mr. C. G. Dunster will in future carry on alone the business of Dunster & Bacon, electrical engineers, 19, North Holmes Road, Canterbury.

J. H. Tucker & Company, Limited, of Birmingham, have removed their London office from 217, Shaftesbury Avenue, to 101, Dean Street, W.1.

The Eastern Counties Gas Managers' Association visited the works of Messrs. The Davis Gas Stove Company, Limited, of Luton, on April 27.

Horace Green & Company, motor and dynamo manufacturers, of Cononley, Yorks, have established a branch at Amberley House, Norfolk Street, London, W.C.2.

Mr. W. Richards, A.M.I.Mech.E., is establishing himself in business as a consulting production engineer and tool designer at "Ashcroft," Rodborough, Gloucestershire.

Mr. A. Scott, Parksworth House, 30, City Road, London, E.C., has been appointed London and district agent for the Victoria Brass Foundry Company, Limited, of Edinburgh.

Arthur Jones & Company, of 15, Dock Street, Middlesbrough, have been appointed sub-agents for Middlesbrough and Tees-side under the Simplex and Credenda joint sales service.

The Federation of British Industries has lodged with the Railway Rates Tribunal a formal application for a reduction of the rates for the carriage of merchandise to 50 per cent. above the 1914 level.

The annual meeting of the Keighley Association of Engineers was held on April 28. The membership is 384, compared with 420 last year. Mr. J. McNish was elected president for the ensuing year.

The first meeting of the Committee to inquire into complaints with regard to the sale of wire nails, hooks and eyes, and snap fasteners manufactured in Germany and Czecho-Slovakia, has been postponed until May 15.

The Eastern Armature Winding Company, of Shadwell, who have acquired the business of Semco, Limited (in liquidation) have established branches at 19-20, High Street, Shoreditch, and 53, Cotton Street, Poplar, London.

The first of a course of lectures on advanced metallurgy, to the students of the Applied Science Department of the University of Sheffield, was delivered on May 2 by Dr. Desch, Dean of the Faculty of Metallurgy at the Applied Science Department.

W. T. Sargant & Sons, metal brokers, 6, Mincing Lane, London, E.C., have acquired an interest in the business of the Vernon Metal and Produce Company, Inc., New York. Mr. N. T. C. Sargant becomes president and Mr. T. H. Sargant, a director of the company.

Mr. F. T. Hewson, formerly superintending engineer for Drake & Gorham, Limited, together with Mr. H. V. Lown, have established themselves in business under the style of Hewson & Lown, as electrical and general engineers, at 22, Noel Street, Oxford Street, London, W.1.

Many thousands of pounds damage was caused by fire last week at the old National Shell Factory at Landore, near Swansea, now occupied as an engineering department by Baldwins, Limited. All the workmen got safely out. The factory, which contained large quantities of valuable plant and machinery, was completely gutted.

The president of the Tidewater Company, Sidney Inlet, Vancouver Island, is quoted as authority for stating that a Sheffield steel firm and the Krupp interests of Germany are testing samples of magnetic iron ore from his company's property, in order to ascertain whether the quality of the product would warrant its shipment to Europe.

Officers of the North-East Coast Institution of Engineers and Shipbuilders have been elected for the ensuing year as follows:—President, Sir Archibald G. Ross; vice-presidents, Messrs. W. N. Bartram, Harry Walker, T. H. Patterson, and H. Annison; ordinary members of Council, Messrs. F. R. Noton, John McGovern, H. I. Brackenbury, and R. J. Eyres; hon. treasurer, Mr. R. H. Winstanley.

Messrs. Royce, Limited, Trafford Park, Manchester, have received an order from Messrs. Kerr, Stuart & Company, Limited, of California Works, Stoke-on-Trent, for four Royce standard 3-motor overhead electric travelling cranes, each of 40-tons capacity, and fitted with a 10-ton auxiliary lifting barrel. These cranes are for works in India.

Presiding at an extraordinary general meeting of Henry Bessemer & Company, Limited, at Sheffield, on May 1, Mr. A. G. Longden said he could see no hope of the payment of a dividend next year. He would be misleading the shareholders if he gave an optimistic view. He failed to see any prospect of an improvement in the steel trade in 1922.

Before a meeting of the Institution of Mechanical Engineers, held on April 28, Prof. E. G. Coker, M.A., D.Sc., F.R.S., and Mr. K. C. Chakko, read a paper entitled "An Account of Some Experiments on the Action of Cutting Tools," being a description of some experiments which have been made by aid of polarised light at the suggestion of the Cutting Tools Research Committee.

The Liverpool Overhead Railway have placed an order with Gent & Company, Limited, for a system of their "Pulsynetic" electric clocks. Waterproof impulse clocks in cast-iron cases are being fitted at every station on the system, also in signal cabins, power stations, and administration departments, and all are controlled from a master clock or "transmitter" fixed at Dingle Station.

John M. Henderson & Company, King's Works, Aberdeen, inform us that they have made arrangements with Mr. F. G. Mitchell, of the Mitchell Conveyor & Transporter Company, Limited, contracting engineers, Atlantic House, 45-50, Holborn Viaduct, London, E.C.1, to undertake the manufacture of Krom crushers, Maxecon mills, and new-type Kent mills, for that company. They have also acquired joint selling rights of these machines.

When the Genoa Conference is ended a steel trade deputation will leave Sheffield for Italy, with the object of securing some modification of the proposed tariffs, which, if carried into effect, will stop in a large measure Sheffield trade with Italy. The deputation has been appointed by the Sheffield Chamber of Commerce and will consist of the president of the Chamber (Mr. William Clark), Mr. Peter MacGregor and Mr. J. C. Ward. The Board of Trade is giving the deputation all possible assistance.

The amount of tonnage launched from Scottish shipyards during April is perhaps smaller than that for any other monthly period in the history of the industry. This, of course, is due to the labour troubles which have affected operations during the whole of the month. The total for the month is three vessels, only one of which is a cargo steamer. This vessel, which was built by the London and Montrose Shipbuilding & Repairing Company, is a vessel of 800 tons gross.

In giving his opinion of trade prospects to a meeting of the local Unemployed Committee, Captain William Gray, of Wm. Gray & Company (1918), Ltd., remarked that he was afraid the outlook was no brighter. His firm was quoting continually for ships. On an average they quoted for three or four a week, and in every case they based their estimate on the cost of the ship without profit. They found in the majority of cases that they were £3 or £4 per ton above what owners were prepared to pay.

The annual meeting of the Institute of Marine Engineers was held on April 28. The retiring president, Sir Joseph Maclay, was prevented from attending, and in his absence Mr. Summers Hunter, past-president, took the chair. The business included the election of the new president, Engineer Vice-Admiral Sir George Goodwin. The Denny gold medal was presented to Mr. H. McCririck. The thirty-third annual report showed that the membership had increased from 2,355 to 2,629, while the gross income was £4,591, an increase of £1,339. The expenditure had increased by £1,019, chiefly due to general expenses, rent, rates, and taxes.

I.B.F. President's Visit to America.

On leaving New York Messrs. Stubbs and Firth made a short stop in Washington, departing for Pittsburgh Sunday night, April 23. Several days were spent in that city visiting and inspecting various industrial plants under direction of C. S. Koch. A formal dinner was tendered at the Duquesne Club Tuesday night, April 25. The British guests spent three days in Cleveland, where the foundry and allied industries of that city entertained them at the Union Club Friday night, April 28, while various plants visitations and informal receptions served to engage the remainder of their time in Cleveland. From here the party went to Detroit, where they are to be entertained under the direction of Fred Erb, foundry manager, Packard Motor Car Company. Chicago and Milwaukee will be visited before Messrs. Stubbs and Firth return East, stopping on their way at Niagara Falls, Worcester, Mass., Naugatuck, Conn., and terminating their tour at Boston.

IRON AND STEEL MARKETS.

Pig-iron.

The prolongation of the dispute in the engineering industries is undoubtedly responsible for the stagnant conditions now experienced in the pig-iron markets, which, with the exception of a fairly active business in exports, are practically idle so far as home consumers are concerned. The demand for foundry iron, the only remunerative quality of late, has developed further weakness, and in the Midlands, failing an early revival, some smelters threaten to damp down furnaces until the position improves. In South Staffordshire also the inquiry for forge iron is on a minimum scale, while at present none of the plants are producing part-mine or other of the better class pig. In the West of Scotland business in the pig-iron market continues discouraging, and buying is only on a hand-to-mouth scale. But here the export figures are better again, the tonnage shipped abroad from the Clyde last week being 1,188 tons, as compared with 127 tons for the same week last year. The quantity shipped from the Clyde for the four months, ending April 30, is 8,235 tons, as compared with 2,562 tons for the same period last year. In the Cleveland market, although well attended, the volume of business is by no means in a corresponding ratio, the home demand having diminished to very small proportions, while the foreign inquiry is much less active. Italy and Belgium are now buying only sparingly, and the competition for the Scandinavian trade is also very keen, Germany being still the best customer for Cleveland pig. The exports of pig-iron from the Port of Middlesbrough (including Skinningrove, 5,665 tons) amounted during April to 44,183 tons as compared with 43,001 tons in March, an increase of 1,182 tons. The shipments abroad were down by 2,337 tons, the figures being 27,603 tons as against 29,940 tons in March. The Scottish demand for Cleveland pig-iron has fallen off in a most marked degree, and even the offer of No. 3 G.M.B. at the fixed price of 97s. f.o.t. Grangemouth fails to attract buyers. To all other destinations the following uniform prices are quoted :—No. 1 Cleveland and silicious 95s., No. 3 G.M.B., 90s., No. 4 foundry 87s. 6d., No. 4 forge 85s., mottled and white 80s. per ton.

Sales of East Coast mixed numbers are reported as low as 95s. to 95s. 6d. per ton for export, but not less than 96s. is asked for home consumption, and some of the makers refuse to take less than 97s. per ton, No. 1 in all cases being quoted at 1s. per ton premium.

Finished Iron.

Business in the finished iron branches continues in an unsatisfactory condition, and is suffering not only from a diminished demand, but also from a weaker tendency of prices. One of the most disturbing elements of the position is the present high costs of production, while manufacturers find it increasingly difficult to regain lost trade while faced with the competition of the rolled steel products. In addition, they are also subject to the unfavourable conditions prevailing in such consuming industries as shipbuilding and constructional work. Some of the cable iron makers are experiencing a bad time, as are nut and bolt iron manufacturers, as has been evident from the prices which have been quoted recently. Marked bars are in moderate sale, but some of the other superior irons which rank just below marked are very inadequately supported, and the price consumers quote is such that offers are frequently declined. Some of the firms of good repute for this class of iron have had their iron mills standing idle for over twelve months. To get them going again on the paying basis they require reductions in fuel, pig-iron and wages; at any rate, their costs will have to be reduced appreciably before they can come down to the only possible market levels now prevailing. Quotations :—Marked bars, £13 10s. (net f.o.t. makers' works); crown bars, £11 to £11 10s.; gas strip, £11 10s.; both net delivered Birmingham area.

Steel.

The protracted dispute in the engineering industry is having an exceedingly depressing effect upon the steel trade, so far as home consumers are concerned, manufacturers in Sheffield now concentrating mostly on the overseas markets as a chief source of orders, some fairly promising inquiries being lately reported. The demand for billets is only limited, and requirements are easily met. Quotations, which are pretty firmly held, are :—Basic billets, soft, £7 15s.; medium, £8 15s.; hard, £9 5s.; acid, Siemens, £10; Bessemer, £12 10s. In the West of Scotland the steel branch of industry is slightly better, and prices have hardened a few shillings per ton. Sheet makers are quiet again after having a fairly good spell for export. The demand in the home trade is exceptionally poor, and the labour troubles here can also be seen in the small tonnage offering. Prices remain unchanged. The export trade is not quite so good this week, and shows a considerable falling off in actual business placed. On the North-East Coast many of the works remain idle, while those still operating are only intermittently employed, and far below capacity. The exports of manufactured iron and steel from Tees-side ports during April amounted to 42,719 tons as compared with 58,746 tons for March, a decrease of 16,027 tons, but still considerably better than the February total of 26,268 tons.

Scrap.

Movements in the various markets for scrap metal differ considerably, both as regards demand and the volume of business passing, and in the exceptional circumstances now prevailing there seem to be few openings for a really active trade. At Middlesbrough the scrap market has been practically at a standstill owing to the engineers' lock-out and the suspension of deliveries. Quotations are, however, unchanged, as follows :—Heavy steel scrap, 60s. to 62s. 6d.; steel turnings, 42s. 6d. to 45s.; cast-iron borings, 42s. 6d.; heavy wrought iron machinery scrap, 62s. 6d.; ditto, piling, 62s. 6d.; ditto, forge, nominal, 67s. 6d. to 70s.; heavy cast-iron machinery scrap in handy pieces, 82s. 6d. to 85s.; ditto, ordinary kinds, 75s. to 77s. 6d. All delivered works.

Tinplates.

Although somewhat less active than has been the case of late the week's tinplate market has maintained a steady tone, most makers having fairly well-filled order-books over this quarter, and holding firmly to previous quotations, current prices for I C 14 x 20 cokes ruling at 19s. 3d. per box, f.o.b. for June. Other quotations may be called :—I C 14 x 20, 112 sheets, 108 lbs., 19s. 6d. to 19s. 9d. per box; I C 28 x 20, 112 sheets, 216 lbs., 39s. to 40s. per box net, f.o.b. Wales. Coke Wasters : A moderate business is reported on the week. Quotations may be called :—C. W. 14 x 20, 108 lbs., 17s. 6d. to 18s. per box; C W 28 x 20, 216 lbs., 35s. 6d. to 36s. per box; C W 14 x 18¾, 110 lbs., 18s. to 18s. 6d. per box; C W 20 x 10, 156 lbs., 23s. 6d. to 24s. per box, f.o.b. Wales, net cash.

Metals.

Copper.—During the past week the market for standard copper developed a firm tone, and closed with a substantial volume of business. The feature of the recent buying has been the demand for rough copper in Liverpool for consumption both in this country and on the Continent. It is a long time since buying of this nature has been noticeable. Stocks of the favourite brands are rather low, and as much as 5s. a ton premium has been paid for specific brands of ordinary rough copper. There has been an improvement in the American demand. Closing prices :—Cash : Wednesday, £60 2s. 6d.; Thursday, £60; Friday, £59 17s. 6d.; Monday, £60 5s.; Tuesday, £60 5s. Three months : Wednesday, £60 15s.; Thursday, £60 10s.; Friday, £60 7s. 6d.; Monday, £60 12s. 6d.; Tuesday, £60 12s. 6d.

Tin.—The week's markets for standard tin developed some irregularity, lowest prices quoted in Eastern cables influencing an easier tendency in values. Deliveries in America are on a large scale, and a moderate demand is being experienced from home consumers. A fair quantity of English tin is being taken out of warehouse for shipment to the U.S. The Continent is not buying much at present, but there is no doubt that the general demand for tin has considerably increased. Closing prices :—Cash : Wednesday, £150; Thursday, £148 10s.; Friday, £149 15s.; Monday, £149 5s.; Tuesday, £148 15s. Three months : Wednesday, £151 7s. 6d.; Thursday, £150 2s. 6d.; Friday, £151 2s. 6d.; Monday, £150 15s.; Tuesday, £150 5s.

Spelter.—The market for this metal has been consistently steady of late, prices having a firmer tendency, while quite a fair volume of buying is in evidence. Closing prices :—Ordinary brands : Wednesday, £27 10s.; Thursday, £27 2s 6d.; Friday, £27; Monday, £27 5s.; Tuesday, £27 5s.

Lead.—In the market for soft foreign pig the feature of late has been the widening of the contango, which makes it extremely difficult to buy for early delivery. English quality is, however, steady and unchanged. English closing prices : Wednesday, £25; Thursday, £25; Friday, £25; Monday, £25 10s.; Tuesday, £25 10s.

XUM

Company News.

Gordon Armstrong (Hull), Limited.—Capital £5,000 in £1 shares. Engineers. Registered office: 7, Bourne Street, Hull.

Gordon Armstrong (Beverley), Limited. — Capital £10,000 in £1 shares. Engineers. Registered office: 19, Eastgate, Beverley.

Machinery Accessories, Limited.—Capital £500 in £1 shares. Director: L. S. Temple. Registered office: 7, Woodfall Street, S.W.

R. Crisp, Limited.—Capital £2,000 in £1 shares. Engineers. Directors: F. J. Wrottesley, Capt. F. R. Wrottesley, and R. Crisp.

Ralshaw & Company, Limited.—Capital £10,000. Steel makers, etc. Permanent directors: H. W. Shaw (chairman) and W. Shaw.

Gardner Engines (Ireland), Limited.—Capital £3,000 in £1 shares. Directors: K. Edwards and C. K. Edwards. Registered office: 94-6, Middle Abbey Street, Dublin.

Kay & Burton, Limited.—Capital £1,000 in £1 shares. Engineers. Directors: C. Y. Burton and F. Kay. Secretary: C. Burton. Registered office: 94, Market Street, Manchester.

St. Regulus Engineering Company, Limited.—Capital £10,000 in £1 shares. Directors: L. Pollack, G. Campbell, V. Huggins, and H. Isaac. Registered office: 5, Gloucester Street, Clerkenwell, E.C.

Level-Protractor Engineering Company, Limited.—Capital £2,000. Directors: J. Sutter, E. H. Newton, and W. C. J. Schlie. Registered office: 3, St. Georges Terrace, Brearley Street, Birmingham.

Robert Stephenson & Company, Limited.—Profit, £21,553; depreciation, £15,000; brought forward, £61,540; available, £83,094; dividend, 5 per cent. for year, less tax, £9.625; carry forward, £73,469.

A.B.C. Coupler & Engineering Company, Limited.—Profit, £11,252; brought forward, £5,778; ordinary dividend, 3d. per share (or 5 per cent. per annum), less tax; reserve, £4,500; carried forward, £6,770.

Sturge & Baker, Limited.—Capital £8,000 in £1 shares (1,500 6 per cent. cumulative preference and 6,500 ordinary). Electrical accessories manufacturers. Registered office: Premier Works, Sheepcote Street, Birmingham.

Deaths.

Mr. H. C. Longsdon, for many years managing director and chairman of Summerscales, Limited, Keighley, died recently.

Mr. L. Connop, the head of the firm of Messrs. Connop Bros., chain manufacturers, of Station Street, Cradley Heath, Staffs., died on May 1.

Mr. C. G. Robertson, works manager at Vickers' Naval Construction Works, Barrow, died at his residence, Cavendish Park, Barrow, on May 1.

Mr. E. Miller, secretary of Richard Hill & Company, Limited, Middlesbrough, who had been in the service of the company for over 42 years, died recently.

Mr. Samuel Lowe, Dartford House, Regent Street, Stoke-on-Trent, who had been in indifferent health for some time, died recently. The deceased was chairman of the directors of Dean & Lowe, Limited, ironfounders.

Mr. R. S. Marshall, of Marshall & Duguid, engineers and boilermakers, Bo'ness, died recently in his sixty-fourth year. The deceased gentleman was an ex-Provost Marshal, from which office he retired in 1910, and was for many years a member of the Bo'ness Town Council.

Mr. J. B. Garnham, senior partner of J. B. Garnham & Sons, metal merchants, 44, Devonshire St., London, W.C.1, died on April 20, in his eightieth year. The deceased gentleman has been connected with the metal and scrap trades for over half a century, and was at one time hon. treasurer of the Metal and Waste Traders' Association.

Sir John Scott, Bart., died at his residence, Danby Lodge, Darlington, on April 29. The deceased was the eldest son of the late Sir Walter Scott, of Riding Mill, Northumberland. The deceased was born in 1854, and succeeded his father as the proprietor of the Tyne Brass and Tube Manufacturing Company, Jarrow, and as a leading member of the firm of Walter Scott & Middleton, Limited, contractors. He had carried out many large contracts in the construction of reservoirs, dock works, etc., in various parts of the country and abroad.

Personal.

The late Mr. J. N. Greenall, of Burlington Road, Nottingham, late managing director of Danks & Company, Limited, engineers, left £23,255.

Mr. Stanley G. Flagg, Junior, who was president of the American Foundrymen's Association, proposes visiting the International Foundry Trades' Exhibition.

Mr. W. Cowan, a director of Parkinson & W. and B. Cowan, Limited, who died on February 18, left personal estate in the United Kingdom valued at £70,011.

Mr. J. G. Kinghorn, of the Metallic Valve Company, and late of Messrs. Kinghorn Brothers, who died on February 17, left estate of the gross value of £68,900.

The late Mr. W. Andrew, of Birmingham, the representative for many years of Samuel Osborn & Company, Limited, Sheffield, left £8,625, with net personalty £7,928.

Mr. F. Crowther, of Henry Crowther & Sons, Limited, engineers, Cleckheaton, who died on March 23, has left property of the value of £19,447, with net personalty £18,255.

M. Ronceray, of the Etab. Ph. Bonvillain et E. Ronceray, has been appointed technical advisor to the foundry and pattern-making departments of the Ecole Nationale d'Arts et Metiers, at Paris.

Mr. J. Walton Harrison, who has been in the service of Richard Hill & Company, Limited, Middlesbrough, for the last 32 years, has been appointed secretary in place of the late Mr. E. Miller.

Lieut.-Col. C. F. Hitchins, who recently resigned the appointment of general manager of Agricultural & General Engineers, Limited, has joined Sir W. G. Armstrong, Whitworth & Company, Limited.

Mr. F. M. Jones, formerly of the British Thomson-Houston Company, Limited, and until lately assistant general manager of Messrs. Boving & Company, and Electro-Metals, Limited, has joined the staff of W. H. Allen, Sons & Company, Limited, Bedford.

Professor A. H. Leahy, Dean of the Faculty of Arts at Sheffield University during the past six years, has resigned owing to ill-health. Professor Leahy is well known to a large number of engineers and metallurgists who have been trained at Sheffield University.

Development of the scheme for the commercial use of the magnesian limestone in the Don Valley is proceeding apace. There is estimated to be a total reserve of eight million tons in a strip of land over a mile and a-half long lying between the Conisbro' sewage works and the Warmsworth lime works.

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